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AGE CLASS AND SIZE GRADE TESTS OF PONDEROSA PINE PLANTING STOCK IN THE CENTRAL AND NORTHERN SIERRA NEVADA

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Ponderosa pine (*Pinus ponderosa* Laws.) trees have been planted for reforestation in California for more than fifty years, but all factors affecting planting stock survival have not been tested critically. The work that has been done in recent years points out that survival is improved if the planting site is properly selected and thoroughly prepared (Buck, 1959). Laboratory research has shown that ponderosa pine is in best physiological condition for planting in California during winter and spring because the root regenerating potential is optimum during this season (Stone and Schubert, 1959; Stone and Benseler, 1962; Stone et al., 1963).

Two important characteristics of planting stock are age class and size grade. These have been tested to a considerable extent on native pines in other parts of the United States such as the southern states (Wakeley, 1954; Grieve, 1960; Silker, 1960; Shipman, 1960; Swearingen, 1963; Ursic, 1963); the northeast (Rudolph, 1935; Curtis, 1955); and the midwest and northern Rocky Mountains by Reed (1955) and Wahlenberg (1928) respectively.

We have little information on best age classes and size grades of ponderosa pine planting stock in California. Some foresters specify two-year seedlings or 1-1 transplants as giving best results (Show, 1930; Fowells, 1953). Recently the U. S. Forest Service has found that good quality one-year seedlings are giving satisfactory results (Buck, 1962). Research by the Pacific Southwest Forest and Range Experiment Station related nursery seed bed densities to size of seedlings and survival in the field. Small seedlings from beds denser than 40 to the square foot afforded poorer survival than larger ones from less dense beds (Baron and Schubert, 1963).

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The Division of Forestry from 1959 to 1964 conducted a number of reforestation studies to compare survival of different age classes, and survival and growth of size grades of ponderosa pine seedlings planted in the field.

Age Class Comparisons

Six small cooperative plantings on private land, although not designed for statistical analysis have indicated that 1-0 seedlings survive as well as 2-0. Table 1 summarizes results of the plantings.

Table 1. Summary of age class comparisons of ponderosa pine planting stock in the northern and central Sierra Nevada.

Test area <u>a/</u>	Elevation	Year Planted	Number Planted		Survival Per cent	
			1-0	2-0	1-0	2-0
Calaveras County						
1 Associated Deck	4,000	1959	800	600	75	64
2 Forest Creek Burn	5,000	1960	2,400	2,400	69	60
Butte County						
3 Carlyle Burn	3,500	1960	491	540	21	21
4 Carlyle Burn	3,500	1961	300	1,200	77	84
5 Carlyle Burn	3,500	1962	800	400	78	87
Amador County						
6 Winton Bear Clover	4,500	1961	90	90	24	37

a/ Cooperators furnishing land for the studies are listed by test area as follows:

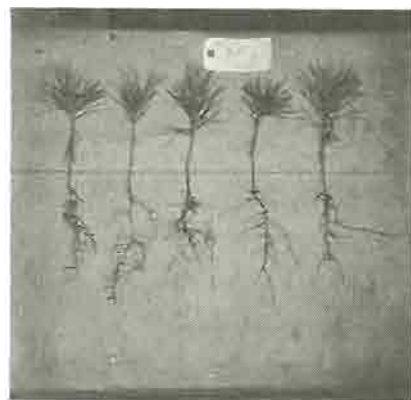
- 1 American Forest Products Corporation
- 2 Winton Lumber Company and American Forest Products Corporation in joint ownership
- 3, 4, and 5 Diamond National Corporation
- 6 Winton Lumber Company

It will be noted that survival in test areas 3 and 5 was much poorer than the others. Area 3 was not accessible for planting until early May, and planted seedlings subsequently did not have

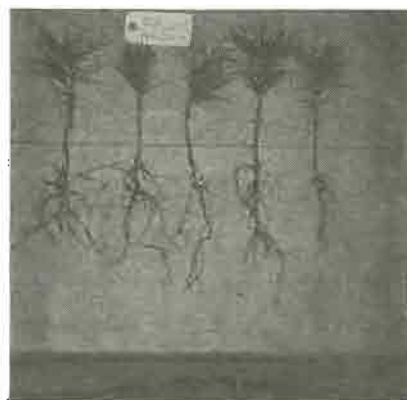
the benefit of rain to maintain soil moisture for sustained root development. Planting in area 5 was done in late fall in plots containing a dense ground cover of bear clover (*Chamaebatia foliolosa*) sprayed with herbicides. Although top kill of bear clover was good, the mass of dead tops and roots prevented packing soil firmly around the roots of seedlings. Obviously, planting under such adverse conditions is not recommended, but indications are that 2-0 may be more able to withstand them than 1-0. Also, 1-0 appeared to be more susceptible to deer browsing in several areas. In most cases this did not affect survival, but did limit growth for a year or two.

Size Grade Comparisons

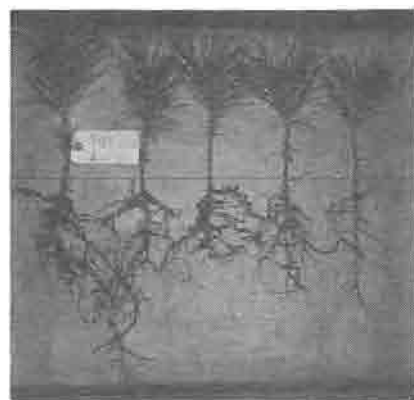
Two studies were designed to determine field success with different size grades of planting stock. The first trial called the Associated Deck Study was planted in late March 1959. It was located in Calaveras County at an elevation of 4,000 feet. The soil, classed as Josephine, is a clay loam developed over schists; rainfall is from 30 to 55 inches a year; and average January and July temperatures are about 45 and 70 degrees F. respectively. Only 2-0 ponderosa pine grown at the Magalia nursery in Butte County was tested (Fig. 1). Criteria for the size grades are found within Table 2.



Small - less than 0.15"



Medium - 0.15" to 0.20"



Large - more than 0.20"

Fig. 1. Typical size grades of 2-0 ponderosa pine planted on the Associated Deck Reforestation Study.

Analysis of survival counts shows that there was no significant difference at the one per cent level (Jeffers, 1959) between the medium and large grades, but both were superior to the small grade. Growth of the large grade was significantly better than the small, but there was no difference between small and medium or medium and large (Fig. 2).

Fig. 2. Measuring heights of ponderosa pine planted in March 1959 on the Associated Deck Reforestation Study. Stock was 2-0 segregated into three size classes.

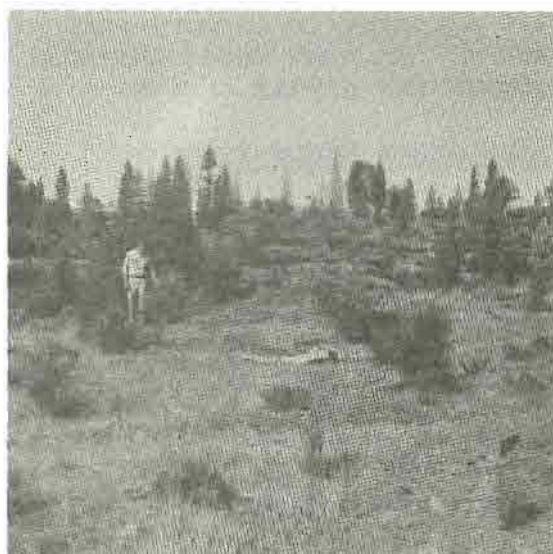


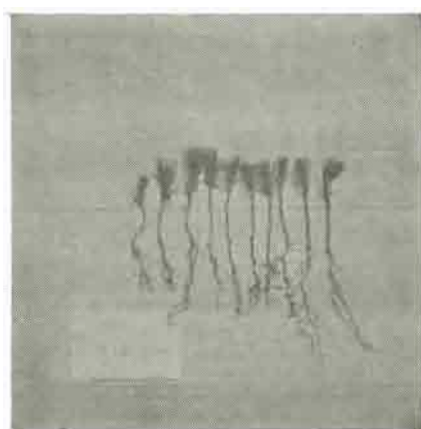
Table 2 shows survival per cents and mean heights at the end of four growing seasons.

Table 2. Fourth year survival and heights of three size grades of ponderosa pine 2-0 planted in the Associated Deck Reforestation Study, March 1959.

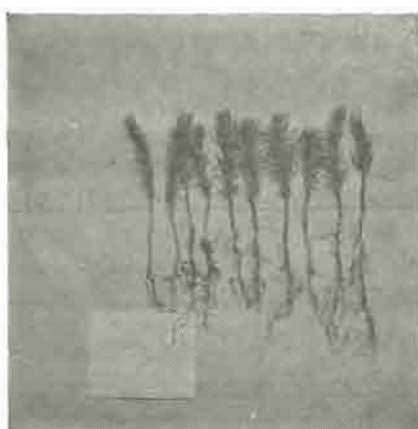
Size grades by stem caliper		Survival per cent	Heights in inches	
Small	< 0.15"	54.8	16.5	**
Medium	0.15" to 0.20"	70.4	20.7	
Large	> 0.20"	73.3	23.3	

** Figures within brackets are significantly different from other bracketed figures at the one per cent level (99 chances out of 100 that differences are due to treatments and not to chance).

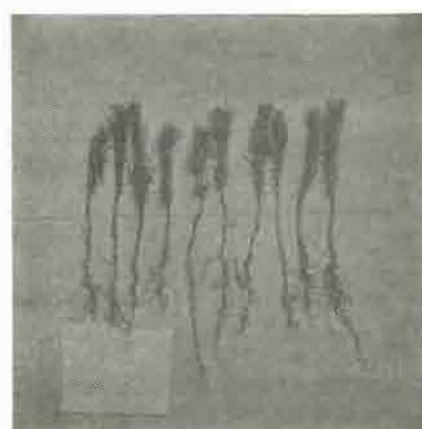
The second study, planted in early April 1960, is located at 5,000 feet on the Forest Creek Burn in Calaveras County. Slightly different results were obtained, possibly because of better site quality than the lower elevation location. The soil series is Cohasset, a loam on andesite. Soil moisture appears to be more adequate, and average temperatures are about five degrees lower than the 4,000 foot site. Size grades for the *Magalia* nursery-grown stock were based on stem calipers shown within Table 3. Samples of graded seedlings are shown in Fig. 3.



1-0 small - $2/32''$ to $3/32''$



1-0 medium - $3/32''$ to $4/32''$



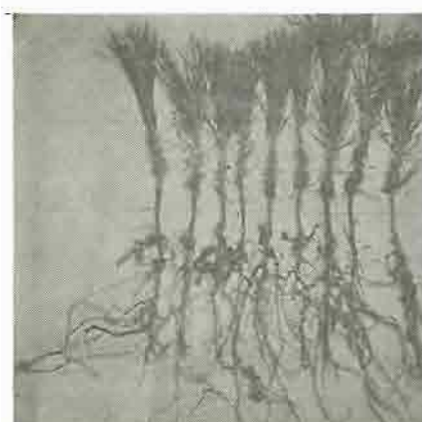
1-0 large - more than $4/32''$



2-0 small - $3/32''$ to $4/32''$



2-0 medium - $4/32''$ to $6/32''$



2-0 large - more than $6/32''$

Fig. 3. Grades of 1-0 and 2-0 ponderosa pine planted on the Forest Creek Burn.

Some 2-1 stock was planted in the study also, but because of its uniformity was not graded according to size. Analysis indicates there was no significant difference even at the five per cent level in survival between size grades within the 1-0 and 2-0 classes. Neither was there a difference in height between grades of 1-0. Within the 2-0 however, the large stock grew faster than both the small and medium grades, but there was no height difference between the small and medium grades. Height differences of 2-0 were significant at the one per cent level. Survival and growth of the three age classes, 1-0, 2-0, and 2-1, in the Forest Creek Burn study could not be compared reliably because seed sources of the three classes were not the same (Stone, 1962). Table 3 summarizes survival per cent and growth within age classes four years after planting.

Table 3. Fourth year survival and heights of three size grades of 1-0 and 2-0 ponderosa pine, and 2-1 ponderosa pine not graded, planted on the Forest Creek Burn, April 1960.

Size Grade	Age Class								
	1-0			2-0			2-1		
	Stem caliper	Survival per cent	Mean height in feet ^{a/}	Stem caliper	Survival per cent	Mean height in feet	Stem caliper	Survival per cent	Mean height in feet
Small	2/32" to 3/32"	73.0	2.86	3/32" to 4/32"	68.0	2.68			***
Medium	3/32" to 4/32"	66.0	3.10	4/32" to 6/32"	73.5	3.04			
Large	>4/32"	70.0	3.16	6/32"	73.0	3.54			
							4/32"	72.5	2.83

^{a/} Figures within brackets are not significantly different at the five per cent level (19 chances out of 20 that if differences did occur they would be due to treatment and not chance).

*** Figures within brackets are significantly different from other bracketed figures at the one per cent level (99 chances out of 100 that differences are due to treatments and not to chance).

Nursery Stock Grading Committee

A Nursery Stock Grading Committee made up of Division of Forestry nursery managers and Service Foresters ^{2/} was appointed in the fall of 1963 to determine criteria for grading seedlings in the Division's nurseries. Acting without knowledge of the reforestation studies' results described here, the Committee established minimum grades nearly the same as those indicating best survival and growth in the studies. To determine minimum grade standards, the Committee members lifted samples of seedlings from nursery beds and graded them by ocular estimation of morphological characteristics believed to give best survival in the field. Height of tops and stem diameters at ground level of sampled seedlings were then measured to determine the minimum criteria. For ponderosa pine these were established as shown in Table 4.

Table 4. Minimum standards for ponderosa pine planting stock grown in California Division of Forestry nurseries as determined by the Nursery Stock Grading Committee, 1963.

Age Class	Top height in inches	Stem caliper in inches
1-0	3	3/32
2-0	3	7/64

Conclusions

Based on the 1959 to 1964 ponderosa pine nursery stock age class and size grade studies, and the findings of the Nursery Stock Grading Committee three general conclusions can be made to assist in selection of planting stock:

1. One-year seedlings will survive as well as two-year (2-0) seedlings on average to good planting sites. It is possible that 2-0 is better in more critical situations.

^{2/} Service foresters are employed by the California Division of Forestry in cooperation with the federal government to help small woodland owners achieve better forest management.

2. If one-year seedlings are selected, they should have at least a three inch top with a good fibrous root system, and a minimum stem caliper of 3/32 inch.
3. If two-year stock is selected, seedlings should have at least a three inch top with a good fibrous root system and a minimum stem caliper of 4/32 inch.

Adhering to the recommended standards described above should provide good quality stock for adequate survival if the planting site is wisely selected and prepared and the seedlings handled with care.

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